

Vol. 1, No. 2

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ICHTHYOLOGICAL CONTRIBUTIONS
of the
INTERNATIONAL GAME FISH ASSOCIATION



Swordfish, Sailfish, Marlin, and Spearfish

FRANCESCA LAMONTE
and
DONALD E. MARCY

June 16, 1941

INTERNATIONAL GAME FISH ASSOCIATION
Central Park West at 79th Street
New York City

International Game Fish Association

President: WILLIAM K. GREGORY

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		SWORDFISH <i>Xiphias gladius</i>		
	ADULT			
	Distribution	Greatest Concentration	Size	
ATLANTIC OCEAN	Jamaica, north to Newfoundland and ? Labrador.	Montauk, N. Y. (<i>June-Sept.</i>) Rhode Island (<i>season is June and July; present to Oct.</i>)	Egg to Adult 4 mm.—95 mm. Some of a series from 10 mm.—46 mm.	Straits of M Straits of Me Open Atlant South of East of P Equatorial Rico and I Canaries south of C Stream.
	Cape of Good Hope, to Cape Verde Islands, north to Baltic Sea. Iceland.	Cape Breton, Nova Scotia (<i>July-Oct.</i>)	12½ mm. 18 mm.	"South Atlan Port Sewall, (A.M.N.H)
	Mediterranean. Black Sea; Sea of Marmora; Sea of Azov.	Sicily (<i>April-Aug.</i>)	41 mm.	Gulf Stream (A.M.N.H)
			87 mm.	Gulf Stream (A.M.N.H)
			6 inches	Off Rochedo (<i>British N</i>
			12¼ inches	Italy (<i>Capt.</i>
			22 inches	Italy (<i>Georg</i>
			25 inches	Bay of Napi
			4 feet	Havana, Cul
			4 feet 3 inches	Middle Grov (A.M.N.H)
			5 kg.—200 kg.	{ Sea of Mar { Black Sea.
			"Young" (12"—18")	{ Bay of Napi { Genoa.
INDIAN OCEAN	Off Mauritius. Ceylon.		Some of a series from 10 mm.—46 mm.	East of Mad (<i>Lütken</i>)
PACIFIC OCEAN	Caldera, Chile, north to Santa Cruz Is., California.	Chile (<i>March-Oct., particularly May-Sept.</i>) California (<i>May-Dec.</i>)	43 inches 44⅞ inches	Wainae, Ha Kona, Hawa
	Hawaii. Australia. New Zealand. Japan.	Japan (<i>July-Oct.</i>)	2' to 4'	Hawaii (<i>rep</i>

DISTRIBUTION OF ADULT AND YOUNG

L.		SAILFISH		
YOUNG		ADULT		
Distribution	Greatest Concentration	Distribution	Greatest Concentration	Size
Messina. (<i>Sella; Sanzo</i>) Messina. (A.M.N.H. #14112) ic: (<i>Lütken</i>) Rochedos de São Paulo. uerto Rico, in the North Current. Between Puerto rench West Africa, in the Drift. About 150 miles ape Hatteras, in the Gulf ntic" (<i>Mus. Godeffroy</i>) Florida. . #14470) off Florida. . #14111) off Florida. . #15657) s de São Paulo useum) George Farnsworth) e C. Thomas, 3rd) es (U. S. Nat. Mus.) a (A.M.N.H. #15355) nds, off Rhode Island. . #15658) mora. (<i>Lebedeff. Kessler</i>) les. (<i>Cuvier & Valenciennes</i>)	Messina (June-Dec.)	Atlantic Sailfish <i>Istiophorus americanus</i> (C. & V.) Brazil, north to Woods Hole, Massachusetts. Devon, England.	Bahamas (Bimini; Cat Cay) (<i>season is Dec. & Jan.</i>) Florida (<i>all year; particularly Jan.- March</i>) Port Isabel, Texas (<i>May-Nov.; par- ticularly July & Aug.</i>)	spawn 5.5 mm. 9 mm. 14 mm. 15 mm. 20 mm. 25 mm. 60 mm. 101.9 mm. 7 inches 8" to 1' "2-10 lb "25-30 i
agascar, near Réunion I.		(no common name) <i>Istiophorus immaculatus</i> (Rüpp.) Indian Ocean. Red Sea.		127 mm 18 inches
vaii. (C. M. Cooke, III) ii (Honeyman) orted by Cooke)	Hawaii, in 60-30 fathoms.	Pacific Sailfish <i>Istiophorus greyi</i> J. & E. Peru, to Cape San Lucas, Lower California. (no common name) <i>Istiophorus orientalis</i> (T. & S.) Hawaii. Japan. (no common name) <i>Istiophorus brookei</i> Fowler Tahiti.	Gulf of California (<i>May-Sept.</i>) Panama Bay (<i>April-Nov.</i>)	16.5 mm 38.1 mm 4¾ inch 4¾ inch

SWORDFISH, SAILFISH, MARLIN, AND SPEARFISH

		MARLIN		
YOUNG		ADULT		
Distribution	Greatest Concentration	Distribution	Greatest Concentration	Size
Port Isabel, Texas South Atlantic. (<i>Lütken</i>) French West Africa. (<i>Günther</i>) (<i>Mus. Godeffroy</i>) 30° S. Lat. 25° W. (<i>Günther</i>) (<i>Mus. Godeffroy</i>) Tortugas, Florida. (<i>U. S. Nat. Mus.</i>) Cuba. (<i>U. S. Nat. Mus.</i>) Messina. (<i>Sanzo</i>) 5° S. Lat. (<i>Günther</i>) (<i>Mus. Godeffroy</i>) West coast of Africa. (<i>Cuvier & Valenciennes</i>) Charleston, South Carolina. (<i>U. S. Nat. Mus.</i>) Tarpon Springs, Florida. (<i>Grewy</i>) Gulf Stream, off Miami. (<i>Pflueger-Kaplan</i>) Port Isabel, Texas. (<i>Baughman</i>)	South Atlantic in the Brazil Current.	Black Marlin <i>Makaira nigricans</i> Lacépède France and Spain. Blue Marlin <i>Makaira ampla ampla</i> (<i>Poe</i>) Cuba, north to North Carolina. White Marlin <i>Makaira albida</i> (<i>Poe</i>) Bermuda. Cuba. Texas. Florida, north to Massachusetts.	Cuba (<i>April-July</i>) Bahamas (<i>Jan.-July</i>) Montauk, L. I. (<i>July & Aug.</i>) Florida (<i>Jan.-April</i>) Cuba (<i>March-May</i>) Bahamas (<i>Feb.-July</i>) Ocean City, Md. (<i>July & Aug.</i>)	6¾ lbs. 4 feet
Western Province, Ceylon. (<i>British Museum</i>) Djetta, Red Sea. (<i>Rüppell</i>)		(a Marlin, mistakenly identified as Spearfish, <i>T. brevirostris</i> , by Playfair) Zanzibar		
9° N. Lat. 119° W. (<i>A. M. N. H. #254</i>) West coast of Mexico. (<i>W. Beebe</i>) off Cocos Island. (<i>Field Museum</i>) off Cocos Island. (<i>Field Museum</i>)	Northern South America at eastern end of Equatorial counter current.	Striped Marlin <i>Makaira mitsukurii</i> (<i>J. & Sny.</i>) Japan to California. Hawaii. New Zealand. Australia. Chile. Pacific Black Marlin <i>Makaira ampla marlina</i> <i>J. & Hill</i> Peru. New Zealand. Australia. Hawaii. West coast of Mexico. California. Silver Marlin <i>Makaira ampla tabitiensis</i> Nichols & LaM. Hawaii. Tahiti. ? Japanese Marlin <i>Makaira ampla mazara</i> (<i>Jordan & Snyder</i>) Japan.	Northern Chile (<i>Feb.-July—heaviest run</i>) Hawaii (<i>May-Oct.</i>)	

		SPEARFISH		
YOUNG		ADULT		YOUNG
Distribution	Greatest Concentration	Distribution	Greatest Concentration	
Cat Cay, Bahamas. (<i>Mrs. Henry Sears</i>) Gulf Stream, off Miami Beach, Florida. (<i>Mrs. Fred Borton</i>)		Spearfish <i>Tetrapturus belone</i> Raf. Sicily. ? <i>reported from:</i> North Carolina, Florida, Cuba, Madeira.		No young reported
		(no common name) <i>Tetrapturus illingsworthi</i> J. & E. Hawaii. (no common name) <i>Tetrapturus angustirostris</i> Tanaka Japan.		

Swordfish, Sailfish, Marlin, and Spearfish

FRANCESCA LAMONTE and DONALD E. MARCY

What little we know about the Swordfish-Sailfish-Marlin-and-Spearfish group is scattered through the literature of several countries in an inconvenient and often unavailable form. We have therefore thought it worth while to give a short, summarized account of what is actually known at the present time about these fishes. This seems particularly necessary as the young forms differ so radically in appearance from the adults that they are usually unrecognized.

In this way, we hope to make clear to collectors, especially to big game anglers who are our greatest source of information, just where and under what guise they may expect to find the adults and young of this group.

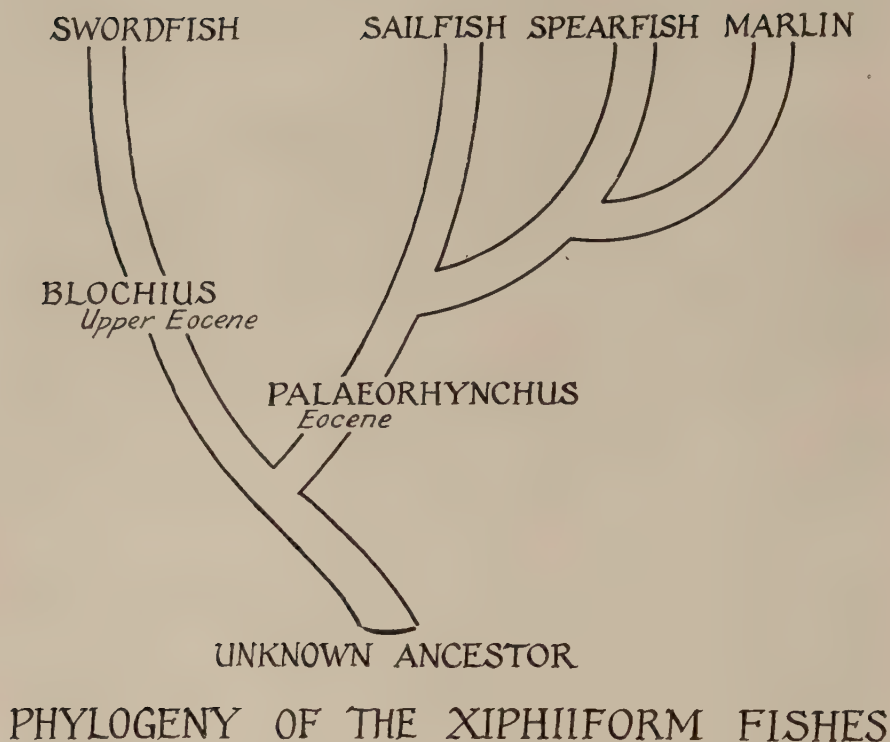
In the chart at the beginning of this article, we have summarized the distribution of adults and young, giving the points of greatest concentration and seasons, when known, and the sizes of young specimens. All the specimens of young listed are known to be actually in the possession of individuals or institutions. The "A.M.N.H." numbers refer to specimens in the collections of the American Museum of Natural History, in New York City.

We have not attempted to repeat at any length material easily available in libraries. Our annotated bibliography consists only of articles pertinent to the aspects of the subject under discussion, and does not represent the entire literature on this group.

The authors wish to acknowledge their gratitude to the Member Clubs, Member Scientific Institutions, and International Committee members of the I.G.F.A. for their generous cooperation in assembling this material, and also to many big game anglers who have supplied us with invaluable data. Because of the war, we are unable to reach Dr. Sanzo, and we have presumed on his past generosity to reproduce one of his figures without the usual courtesy of asking the author's permission.

RELATIONSHIP

As in the case of most modern fishes, the geological record of the Xiphiiformes is far from complete. From this standpoint, however, as well as from that of comparative anatomy, it seems fairly certain that the Swordfish line has been separated from that of the Sailfish, Marlin, and Spearfish since early Eocene times. As shown in the accompanying diagram, the Eocene fish, *Palaeorhynchus*, an elongate fish with thin, cycloid scales and a six-rayed pelvic fin, was probably in the ancestral line of the Sailfish-Spearfish-Marlin group (the Marlins and the Spearfish are probably an offshoot of the Sailfish line); and another fossil fish, *Blochius*, from the Upper Eocene, with a shorter body, no pelvic fins, and bony, diamond-shaped scutes, is probably ancestral to the Swordfish.



Text-figure 1. Phylogeny of the Xiphiiform Fishes.
(modified from Gregory & Conrad, 1940)

DISTRIBUTION

We have set forth in our chart, all the authenticated knowledge available to us to date on the distribution of the young and adult of these fishes.

There can be no doubt about the identification of young of either Swordfish or Sailfish, as a sufficiently large series of both of them is known to establish definite identification.

PLATE I

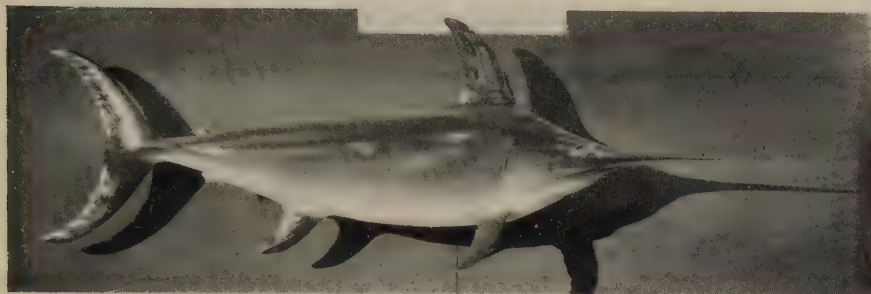


fig. 1: Adult Swordfish. Mount of 601 lb. fish in the American Museum of Natural History, Hall of Fishes of the World. The fish was caught on the Michael Lerner-Cape Breton Expedition of 1936, off Louisburg, Nova Scotia.



fig. 2: Swordfish measuring 4 ft. 3 in., caught by fishermen off Middle Grounds, 80 miles dead east of Newport, Rhode Island. Mounted in the American Museum of Natural History, Hall of Fishes of the World.

SWORDFISH

PLATE II

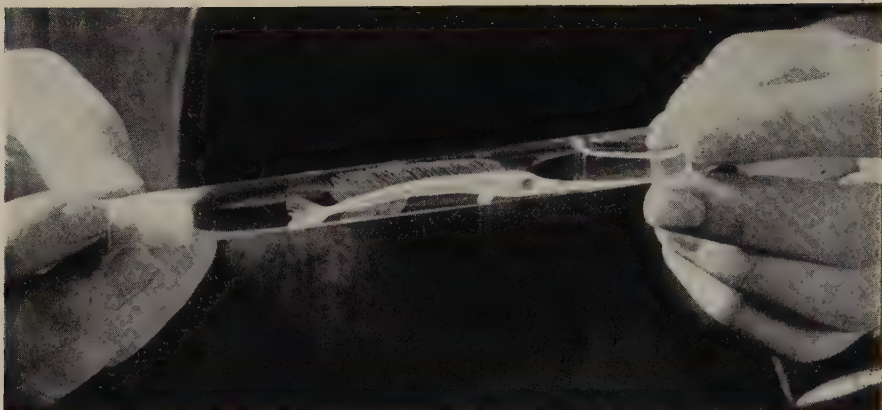


fig. 1: Young Swordfish measuring 95 millimeters, taken off Messina by Dr. Sanzo, and presented to the American Museum of Natural History by the Museo di Storia Naturale, Milan, Italy.



fig. 2: Larval Swordfish measuring 17.6 mm., taken off Messina by Dr. Sanzo, and presented to the American Museum by the Milan Museum.

Drawing by Donald E. Marcy.

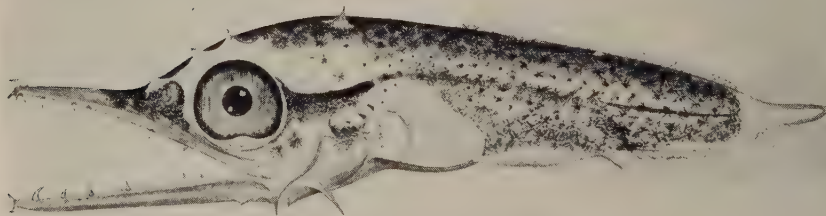


fig. 3: Larval Swordfish of 6.40 mm., taken in the Straits of Messina.

Reproduced from Sanzo, 1930.

SWORDFISH

SWORDFISH

Xiphias gladius Linnaeus

ADULT: There is only one genus and one species of Swordfish, or Broadbill Swordfish, *Xiphias gladius* Linnaeus, regardless of geographical locality.

Size

An adult of 13 ft. 9 in. long, and weighing 860 pounds, caught by Mr. W. E. S. Tucker, off Tocopilla, Chile, is the present world's record catch on rod and reel, and the fish probably reaches a weight of a thousand pounds or more.

Identification

The Swordfish is a powerfully built, streamlined fish, with very strong shoulder muscles. It is distinguished by a short, high dorsal fin; a scaleless bronze or purplish-black body, whitish below; and a broad, flat sword, very different from the cylindrical spear of the other members of the group. It has no pelvic fins, and but one keel on each side of the caudal peduncle. As in the Sailfish and Marlins, the lower jaw is very much shorter than the elongated upper. The mouth is toothless.

Vestiges of the long dorsal fin of the younger stages are to be found, when this fish is skeletonized, in the fin supports for the dorsal, which run almost as far back as to the second dorsal. Unlike the dorsal of the Marlins and Sailfishes, the dorsal fin of the Swordfish does not fold down into a groove in the back.

The external and internal anatomy of the Swordfish have been discussed in detail by a number of authors, references to whose works will be found in our bibliography.

Distribution

The Swordfish is a warm water fish. The Louisburg, Cape Breton run occurs when there is an impingement of warmer offshore surface water on that coast, from the intermittent currents which circle the Gulf of Maine from the east or northeast, and which are warm in summer and fall. The Messina run is obviously a population unit, that is, a self-contained run which spends its entire life in this limited area. It is possible that there are also such units for the North Atlantic, South Atlantic, North Pacific, and South Pacific.

Food

The Swordfish feeds on smaller fishes, such as herring, mackerel, etc., and on squid. The absence or presence of this food supply, and, in turn, the absence or presence of the food supply of the herring, mackerel, etc., largely accounts for the variability in the runs from year to year.

Sex

During the course of the Michael Lerner Expeditions (1936-1941) to Cape Breton, Nova Scotia; Bimini, B.W.I.; Australia and New Zealand; Chile and Peru, no Swordfish in reproductive state were taken, and no young were found. All the fish were inactive, or "resting" females. Off Montauk, Long Island, out of a catch of 27 specimens, two were male; also inactive. In this stage we find it impossible to distinguish the sexes except by making histological sections of the gonads, as in the inactive state, both ovaries and testes are compact, firm, and about the same size.

Due to confusion in reports reaching us frequently from anglers and commercial fishermen, we ask the leniency of ichthyologists for the following explanation of facts well known to them: The sex organs are designated by the term "gonad", which includes both the male organs, or testes, and the female organs, or ovaries. "Roe" means the egg mass of the fish, but unfortunately is also used for the organ itself. This has led to reports of ripe females, subsequently disproved by examination of some of the so-called "roe", which was merely gonad tissue.

Dr. Sella, who was able to examine the breeding fish off Messina, reports that in the reproductive season, the ovaries are enormous in proportion to the size of the fish, but the testes quite small; and that in a female ripe for reproduction, the 'abdominal pore' is dilated, and both 'abdominal pore' and anus [vent] appear swollen and soft.

BREEDING HABITS: Due chiefly to the researches of Dr. Sella and Dr. Sanzo, there is available definite information about the breeding habits and young of the Swordfish. Sella and Sanzo, working off Sicily from 1910 to 1930, have published their results in a series of papers describing the collection and examination of adults ripe for reproduction; eggs extracted from the female; eggs found floating at the surface; eggs hatched in laboratory; and the various developmental stages, with detailed descriptions and fine figures.

Season

These scientists were able to observe the Messina run during the whole year, lacking the three months of January, February, and March, when the fish were presumably quiescent in greater depths than permitted fishing them.

The height of the reproductive season in those waters is June and July (a period when the Montauk, Long Island, run is resting), when the adults approach the coasts in pairs, a male and a female. The female spawns in several different deposits. Although the maximum extrusion is in July, eggs are found until September. Young from ten to thirty centimeters are caught in surface nets in the Straits of Messina in mid August, and one-half to five kilogram fish are fished commercially through December. In April, the adults begin heading toward the coasts, and the cycle begins again.

It is generally believed that the growth rate of the Swordfish continues to be a very rapid one; and there seems also to be a general belief that the fish undergoes a spawning season only about twice during its life, but we have no definite records.

Eggs

The Swordfish egg is round, dimly transparent, and buoyant. The mature egg, from 1.82 to 1.87 mm. in diameter, hatches in about $2\frac{1}{2}$ days.

off Messina

Eggs and young were taken off Messina, and larvae were brought to the thirteenth day out of the egg in the laboratory. Corresponding stages of eggs and larvae were found free in the ocean. With the single exception of the Messina run, the finding

of eggs and young of the Swordfish have been sporadic, and do not prove anything definite as to the breeding places of the various units.

*off the
United States*

Marie Poland Fish reports the finding of a "swordfish with partially matured eggs off Stonington, Connecticut, on July 24, 1924, off Cox Ledge, about twenty miles southeast of No Man's Land. The fish weighed 150 lbs. and contained ovaries of 3.15 lbs. The number of ova was estimated at 16,130,400, measuring from 0.1 to 0.55 mm. . . . There have been, to my knowledge, but two other catches of 'green' [ripening] fish on this side of the Atlantic. Some unrecorded eggs in the Woods Hole collection labeled swordfish eggs, taken from a specimen at Provincetown on September 10, 1909, were further developed and averaged 1.2 mm. in diameter. Another fish, taken on June 25, 1922, and landed at New Bedford, had ovaries weighing fifteen ounces which contained immature eggs. This specimen was recorded in the U. S. Bureau of Fisheries Service Bulletin No. 88. . . . As there has been no evidence that actual spawning has ever taken place on this coast, we may assume that the present specimen merely remained longer than usual before leaving for an unknown spawning ground."

off Cuba

Ernest Hemingway thinks the Broadbill Swordfish must breed off Cuba, "for fish are often taken in pairs full of milt and spawn and I have seen female broadbill so full of roe that the eggs would be expelled in the boat when the fish was moved." (*American Big Game Fishing*.)

A sufficient number of very small Swordfish have been reported from the Gulf Stream off Florida to Cuban waters, to make this area worth while investigating as a possible breeding ground.

YOUNG: Young of the Swordfish in various sizes have been taken all over the world, but for the most part only as single specimens. The sharply toothed jaws of some of the very small stages of this fish, and the fact that in some stages the jaws are fixed open, might easily lead to the larva catching on, and being towed by some other marine organism to some spot far out of its own range.

Hawaii

Mr. C. M. Cooke, III, our International Committee Member for the Hawaiian Islands, tells us that young Swordfish from two to four feet and less are rather common off the island. They are taken from three to twenty miles offshore on flag lines at depths of from six to thirty fathoms. As soon as they are taken off the line, they are chopped up for chum.

Messina

As we have already said, the complete developmental cycle from egg to adult is known off Messina, where there is even a commercial fishery for the small fish. The American Museum of Natural History is fortunate in having received from the Milan Museum one of the series collected by Dr. Sanzo, consisting of five stages, from a seven-day old, 4 mm. long specimen through one of 95 mm.

Turkey

Lebedeff observes that small Swordfish ("from 5 kg. to 200 kg., but never as large as those fished by Zane Grey in New Zealand") are found in large quantities in Turkish waters. He writes:

"They arrive in March in the Sea of Marmora, together with schools of bonitos and mackerel, and are chiefly found near Princes' Island [twenty miles from Constantinople] and near Tuzla, and they leave these places in June, passing through the Bosphorus to the Black Sea. In August they return again via Bosphorus to the Sea of Marmora and remain there until January. During this period they are caught by nets in the night. In January they disappear to an unknown destination and only reappear as stated above, in March.

The best time for capturing swordfish is from March 15 up to the beginning of May. . . . In March and April, swordfish generally keep to the bottom and seldom come up to the surface, but in May and June as the weather becomes warmer they are fond of basking in the sun on the very surface. . . ."

The American Consulate at Istanbul writes us that the Swordfish are caught principally in the Bosphorus and the Sea of Marmora, and very seldom in the Black Sea entrance of the Bosphorus. The annual catch of Swordfish is estimated at about 10,000 kilograms and is consumed locally. They are caught either with lines or with nets.

Through the Consulate General of the Union of Soviet Socialist Republics, in New York City, we have obtained the following information from the All Union Scientific Institute of Sea Fisheries:

"In the Bosphorus the Swordfishing season is from May to the end of November. In Bulgaria they are caught every year in autumn. Their weight is usually within the limits of 20 kg. Swordfish egg and fry catches in the Black Sea are unknown, and there is no sporting Swordfish fishing in the Black Sea."

*Description
of young*

The larvae of the Swordfish hatch out in about $2\frac{1}{2}$ days, and by the second or third day measure four millimeters. This length is not particularly significant as an exact indication of age, as undoubtedly, like that of other Teleosts, the length diminishes with the absorption of the yolk sac. The larvae are cream-colored with traces of orange, and many small, black, star-shaped dots. At no time are there any traces of pelvic fins. The jaws are equal and not prolonged until a body length of some 6.40 mm., when they are both produced into swords, but are still equal in length and both still supplied with strong, sharp, teeth.

*Developmental
stages*

The differences in the various stages of development are most easily shown in Plates I and II. When just hatched, the mouth is not open, and the head is curved downward over the yolk sac. The first stage in our possession, a 4 mm. fish, has equal, unprolonged jaws; the mouth is apparently fixed open;

and there are small spines on the head and gill regions. We cannot see any scales on the body in this stage.

The fixed open mouth seems to be characteristic of the young swordfish from after the absorption of the yolk sac to lengths of somewhere between 13.24 and 17.6 mm. Our 6.5 mm. and 12.5 mm. specimens have the mouth fixed open, as does Sanzo's figure of his 13.24 mm. specimen. In our 17.6 mm. specimen the mouth is almost closed, and in our 18 mm. specimen it is entirely closed, as it is in all the lengths greater than that.

12.5 mm.

At 12.5 mm., the jaws are long, toothed, and still equal; there are spines on the head and gill regions. These spines are always short, and never approach the long, thorn-like processes of the young Sailfish. In the 12.5 mm. stage, the spiky, glassy keel spines of the scales are visible on the body.

23 mm.

At 23 mm., the lower jaw is slightly the shorter; both are still equipped with teeth. The head and body are still spinous.

87-95 mm.

Our 87 mm. and 95 mm. specimens correspond closely to Lütken's Plate II, fig. 10 ("very young swordfish"). The lower jaw is the shorter; both are toothed; the head spines are present. The scales, under an ordinary microscope, are rather triangular in shape. They appear to be keeled, and bear a row of from three to five glassy spines on the low keels. The dorsal is long and of fairly even height, with about 42 rays. Dr. Beebe has kindly had our 95 mm. specimen cleared and stained and will report on his findings in a forthcoming paper in *Zoologica* (*N. Y. Zool. Soc.*).

22 inches

Mr. George Thomas, III has sent us a rather complete set of measurements for his 22 inch specimen referred to in our chart, and a photograph of which may be found opposite page 187 of "American Big Game Fishing". We give the measurements below:

Total length, from tip of spear to mid outer margin of tail.....22 $\frac{1}{8}$ inches
Upper jaw, from tip to angle of mouth.....7 $\frac{1}{2}$ inches
Lower jaw, tip to angle of mouth.....4 inches

[It is apparent from these measurements that the lower jaw is still longer in proportion to the upper than in either the adult or the four foot stage (Plate I)].

Height of dorsal.....3 $\frac{3}{4}$ inches

Dorsal spines.....approximately 40

"First row of small projections" [obviously the spines of the scales; these are figured by Mr. Thomas, in an accompanying sketch, as running down the body in straight lines from behind the gill-cover to the base of the caudal]

about 40

"Second row of small projections".....about 37

"Third row of small projections".....uncountable

"Fourth row of small projections".....about 31

Mr. Thomas states that the tail of the specimen was somewhat distorted in mounting.

4'

Through the courtesy of Mr. Greason, of Teddy's Fish Market, Fulton Market, New York, and of one of the I.G.F.A. vice-presidents, Mr. Ernest Hemingway, we have secured two specimens of young Swordfish measuring slightly over four feet in length. This intermediate stage strongly resembles the adult fish in general appearance. The sword and lower jaw have reached the condition of those in the adult; the spikes have gone from head and gill regions; the dorsal fin looks like that of the adult until it is closely inspected and found to be much longer. The body, at first glance appears to be smooth. However, the specimens have the following marked differences from the adult when closely examined:

Scales in 4'
fish

The skin is thickly set with irregularly overlapping, somewhat triangular-shaped scales, each bearing a series of from three to ten small, transparent, sharp, recurved spines. Dorsally these scales are larger and farther apart, and the spines are larger and less numerous; ventrally the scales are closer together, and the spines more numerous.

Dorsal in
4' fish

The dorsal fin, although decreasing rapidly in height posteriorly, runs with well developed fin rays and membrane to the origin of the second dorsal, and the anal similarly reaches almost to the origin of the small second anal.

Skull and
vertebral
column in
4' fish

Mr. G. Miles Conrad, of the American Museum's Department of Comparative Anatomy, reports on the vertebral column and skull of the Greason specimen as follows:

"The skeleton differs little from the conditions described for the adult by Gregory and Conrad (1937). It is fully ossified and presents but one major difference from the adult. The vertebral column is remarkably like that of the adult. There are fifteen precaudal and eleven caudal vertebrae, including the tail centrum. The centra are of the adult cuboid character, the caudal centra being slightly more elongate than the precaudals. As in the adult, the anterior neural zygapophyses overlap slightly the neural spine of the vertebra immediately in front. Ribs are present on the first three abdominal vertebrae and on the last three; this arrangement is as in the adult. The hypural complex is also as in the adult.

"The skull in general conforms to the adult pattern, except for the presence of a minute bony element lying dorsad to the narial openings and apparently lost in the adult. This bone is undoubtedly the true nasal bone and its lack in the adult has for years led naturalists to term the major portion of the dorsum of the sword the nasal. The swords, spears, and marlin spikes of the Xiphiiformes are merely an elongation of the horizontal and ascending rami of the premaxillaries. The circumorbital bones noted by Cuvier and Valenciennes are represented in this juvenile specimen by a row of minute scale-like bones."

PLATE III

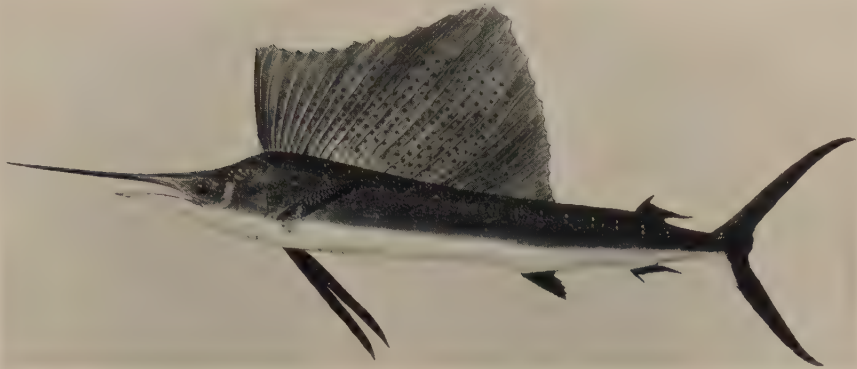


fig. 1: Adult Sailfish. American Museum of Natural History, Hall of Fishes of the World.



fig. 2: 60 mm. specimen.

Reproduced from Günther, 1873-74, Heft. 2.



fig. 3: 16.5 specimen. Collected by J. T. Nichols, American Museum of Natural History, in 9° N. Lat. 119° W.

Drawing by Donald E. Marcy.

SAILFISH

THE SAILFISHES

*Istiophorus**Identification*

ADULT: The Sailfishes, genus *Istiophorus*, and several species, are easily distinguished from the other members of the group by their slender silver body and enormous, high, sail-like, blue or purple dorsal fin which can be lowered into a sheath at its base. Many authors claim that the Sailfish is also characterized by pelvic fins consisting of two or three separate rays, instead of fused rays as in those of the Marlins. Walford, however, states that specimens collected on the California coast had single-rayed pelvics. He thinks this may be peculiar to the Pacific Sailfish.

The pectoral fins are short, and the cylindrical spear is very slender. There are two small keels on the caudal peduncle. The adult Sailfish has elongate, thorn-like, and irregularly arranged scales, and a complete, clearly discernible lateral line.

Size

Sailfishes run smaller than the other fishes in the group. The maximum weight is probably around 200 pounds. The world's record rod and reel Atlantic Sailfish weighed 106 lbs.; the Pacific, 190 lbs.

Food

The fish feeds on smaller fishes.

Species

Five species of Sailfishes are generally recognized by ichthyologists. There can be no particular confusion about them as they are geographically limited.

ATLANTIC SAILFISH. *Istiophorus americanus* (C. & V.) This is common in warmer Atlantic waters, south to Brazil, and has been taken as far north as Woods Hole, Massachusetts, and Devon, England. It is a more robust fish than the Pacific fish; the color is more vivid, and the beak and pectoral fins shorter.

INDIAN OCEAN SAILFISH. *Istiophorus immaculatus* (Rüppell). Found in the Indian Ocean and the Red Sea.

PACIFIC SAILFISH. *Istiophorus greyi* Jordan & Evermann. Peru, north to Cape San Lucas, Lower California. Its body is more slender than that of the Atlantic Sailfish; the dorsal is proportionately higher; the color less brilliant.

ORIENTAL SAILFISH. *Istiophorus orientalis* (Temminck & Schlegel). Japan and Hawaii.

TAHITIAN SAILFISH. *Istiophorus brookei* Fowler. Tahiti.

BREEDING HABITS: Our only knowledge of the breeding habits of the Sailfish is from the reports quoted below. We have never examined a specimen in spawning condition nor seen the eggs of this fish.

*Season**Pacific*

Walford writes that "On the Pacific coast, the young apparently spend their time in rather distant or at least inaccessible places, as specimens weighing less than 50 pounds are a rarity."

Atlantic

He also writes: "It is known that the Atlantic species spawn in late June, July, and August, probably not far from shore for schools of young are seen the following winter."

We cannot find any definite record to support this, although it seems a reasonable hypothesis. Lynn Bogue Hunt, writing in "American Big Game Fishing" states that "It is certain that Sailfish breed in the waters off Florida. . . . All the sailfish anglers of experience, and all the guides and taxidermists I know are agreed that the breeding season off Florida is during late June."

Kaplan (1937) quotes Al Pflueger, the well-known Miami taxidermist, as saying: "Sailfish breed in the Gulf Stream off Miami during May and June, the weight of roe in them being 4-8 lbs., according to size; and sailfish of 2 to 10 pounds are found here from Thanksgiving Day to Christmas."

Mr. J. L. Baughman, who has obviously made very careful and intelligent observations on the Texas run of Sailfish, writes in Copeia:

"Several female fish taken later in the season have had spawn running from them. Of the 18 fish taken at Port Isabel between August first and third, inclusive [1940], 17 were females, with roe in all stages of development."

This would seem to point fairly conclusively to the spawning grounds of one of the runs.

YOUNG: At least seventeen young Sailfishes, ranging in a well graduated series from larval forms of 5.5 mm. and 9 mm. (Günther; Lütken) to individuals weighing 3 lbs. 6 oz. and 5½ lbs. (Jordan and Evermann, p. 44), are known to be in the possession of museums or individuals. These were caught in various parts of the world and have been described in some detail, as noted in our bibliography. Dr. Beebe is having his specimen cleared and stained and his forthcoming publication will doubtless clarify some points on which previous authors have not touched in detail.

*Scales
in young*

One of these points is the absence or presence of scales in the young Sailfish. Lütken says that all his young *Histiophores* of 5½ to 100 mm. were completely naked and wanting in scales. Günther says the body of his 60 mm. Sailfish was entirely smooth. The body of the American Museum's 16.5 mm. specimen is liberally strewn with small pits, which are probably mucous pits. Dr. Beebe, who has examined it for us in his laboratory, reports that he finds undoubted beginnings of scales, indefinite, but at least outlined in places, but that there are as yet no hints of the conspicuous spines which will appear later.

14 mm.
16.5 mm.
compared

Günther's 14 mm. Sailfish is in general similar to the American Museum's 16.5 mm. specimen. There are, however, certain differences, which might be due either to the difference in growth stage or to inaccuracies in Günther's figure.

The eye in the 16.5 mm. specimen is relatively larger than the eye in Günther's specimen, although it would seem that the reverse should be true. The pelvic fins of the 16.5 mm. fish are shorter than those of the 14 mm. specimen. In all of Günther's figures, the tail is forked, whereas in the 16.5 mm. specimen, the tail fin is fusiform, with no evidence of a notch

in its margin. The American Museum specimen has a definite series of notches on the supraorbital margin, as well as thorn-like processes on both upper and lower preopercular spines and on the margins of operculum and preoperculum. Günther's figure shows these processes on the upper, or smaller, spine only. There is also a row of minute notches along the lower margin of the lower jaw in the 16.5 specimen, not shown in Günther's figure.

60 mm.

At 60 mm., the fish has assumed so many of the adult characters that it could not fail to be properly identified, even if only by the sail-like dorsal fin.

*Young in
Gulf of
Mexico*

Mr. Richard E. Grewey, who has fished commercially off Tarpon Springs, Florida, tells us that recently, in October, he took about 50 pounds of fish from a school of Sailfish, averaging from 8 inches to one foot, off that locality. Mr. Grewey says such schools are common off Tarpon Springs. The American Museum is arranging to get specimens for examination.

Mr. Baughman reports that the smallest taken off the Port Isabel, Texas section measured twenty-five and thirty inches.

PLATE IV

fig. 1: Adult Blue Marlin, taken off Bimini, Bahama Islands. American Museum of Natural History, Hall of Fishes of the World.

fig. 2: Young Marlin of slightly over 4 feet, taken by Mrs. F. W. Borton in the Gulf Stream off Miami Beach, Florida, 1932.



MARLIN

MARLIN

Makaira

We are indebted to the Michael Lerner Expeditions of the American Museum of Natural History, and to Mr. Charles M. Cooke, III, our International Committee member for the Hawaiian Islands, for a large part of our Marlin data.

ADULT: There are at least five different kinds of Marlin differing in geographic distribution, range of size, and various characters, but all recognizable as Marlin by certain unchanging external traits.

Size

The smallest of the Marlins is the White Marlin. The world's record rod and reel catch weighed only 104 pounds, and it is probable that the fish does not run over 200 pounds. The largest specimen of Blue Marlin known to us was netted by Havana fishermen, and weighed 1200 pounds; the rod and reel record is a fish of 730 pounds. The world's record rod and reel Striped Marlin weighed 692 pounds, and the highest authenticated weight we have for this fish is Zane Grey's catch which, although much mutilated by sharks, weighed 1040 pounds in its mutilated state. For the Silver Marlin, we have as yet only the rod and reel record weight, 815 pounds.

Members of the Michael Lerner Australia-New Zealand Expedition of 1939 saw the heaviest specimen of Black Marlin on record. This was "Boydton Ben", a fish lassooed and pulled ashore at Boydton, New South Wales, in 1938. It weighed 1226 pounds. The Black Marlin rod and reel record is 976 pounds.

*Identification
Color*

The outstanding external characters of the Marlins are the presence of pelvic fins; the long, cylindrical spear; the long dorsal fin which rises rather gradually at the anterior end to a lobe varying in height in the different species. The startling blue color seen on fin bases, the upper part of the body, and, in some marlins, as vertical stripes, or bands, on the body, fades very quickly after the fish dies, and cannot be used as a diagnostic character, although at the time of capture the vertical stripes are very conspicuous in the Striped Marlin. The rest of the body is usually dark greenish blue above; silvery below. Very shortly after death the fish becomes a uniform greyish black.

Scales

Like the Sailfish, the Marlin is scaled. The scales are sharp, elongate, and like large thorns, more or less irregularly arranged. Those of the Black Marlin are noticeably wider and tougher than those of the other species.

Tail keels

The Marlins have two small keels on each side of the caudal peduncle in contrast to the single large central keel of the Swordfish.

Food

Our examination of the stomach content of Marlins has shown that their diet is much the same as that of the Swordfish. Where smaller fishes are plentiful, they are utilized as food; in Chile, where squid are very plentiful, the Marlin and Swordfish stomachs were always full of partially digested squid.

Sex

The sex organs of the Marlin are much the same in appearance as those of the Swordfish—two elongate, fairly firm, cylindrical organs. The Blue Marlin taken off Bimini and examined by us, and the Striped Marlin we examined off Chile, were all “resting” females. The Australia-New Zealand Expedition got both male and female Black and Striped Marlins, but all were also inactive. “Roe” reported from the Chilean run to prove that the fish off that coast were in reproductive condition, proved to be not eggs, but merely gonad tissue from inactive females.

Species

The scientific nomenclature of the Marlins is undergoing revision. This is fully discussed in Nichols and LaMonte (1941) and since there is little confusion in the common names of the Marlins, we have used these common names in this article.

It is difficult for anyone, ichthyologist or angler, unfamiliar with fresh specimens of all the different kinds of Marlin to determine what he has caught. This is especially true of the Pacific Marlins. However, the problem is simplified by the fact that one of the main differences between the Marlins is geographical.

Atlantic Marlins

The ATLANTIC Marlins are: BLUE MARLIN and WHITE MARLIN. *These do not occur in the Pacific.*

Pacific Marlins

The PACIFIC Marlins are: BLACK MARLIN; STRIPED MARLIN; SILVER MARLIN. *These do not occur in the Atlantic.*

The White Marlin, a slender fish, running much smaller than the Blue, and occurring in the same waters, is easy to tell from the Blue because of its more slender body and spear. There is little danger of confusing the two, as anglers familiar with one are almost always familiar with the other. The Blue Marlin is much more heavily built, with a more decided shoulder hump. The pectoral fins of the White Marlin are more parallel-sided; its caudal lobes are narrower and wider-spreading; its spear is much more slender; and its lateral line more clearly visible.

At first glance, the Striped Marlin is distinguished from the Black Marlin by a much higher dorsal fin. In the Black Marlin, the height of this fin is contained from 2.5 to 2.9 times in the length of the head; in the Striped Marlin, it is only contained from 1.8 to 2.3 times in the head length. Gregory and Conrad (1939) give another difference: In the Black Marlin, the pectoral fin never lies flat against the side of the body, but always remains horizontal. These authors state that this character was observed on all of the Black Marlins examined on the Australia-New Zealand Expedition.

Key to Pacific Marlins

By a few simple measurements, further differences in the Pacific Marlins appear:

Height of dorsal fin (*measure from base of front of fin to*

tip of its highest ray) contained in head (*measure from tip of spear to hind margin of the gill-cover*): 2.5 times or less. Weight at a length of 8' 8" (*from tip of snout to base of tail fin*): from 200 to 300 pounds.

Weight at a length of 9' 4": from 300 to 400 pounds.

.....STRIPED MARLIN

Height of dorsal fin in head: 2.5 or more.

Snout (*measure from spear tip to front margin of eye socket*): 1.4 to 1.5 in the head length.

Weight at 8' 8": averaging 350 pounds.

Weight at 10' 6": 600 pounds or less.

.....SILVER MARLIN

Height of dorsal fin in head: 2.5 or more.

Spear shorter than that of the Silver Marlin; snout 1.5 to 1.7 in head length.

Weight at 8' 8": averaging 350 pounds.

Weight at 10' 6": about 700 pounds.

.....BLACK MARLIN

BREEDING HABITS: Almost nothing is known or reported about the breeding habits of the Marlins. Ernest Hemingway (*American Big Game Fishing*, pp. 76-77) writes:

"White Marlins breed off Cuba in May. They breed in the same way that the grouper does, except that as they are a fish of the current, they breed in the current instead of on a reef. The female Marlin heads into the current while the male heads in the opposite direction, and while they are side by side the female expels the eggs and the male the milt; the male then catches the eggs in the basket-like opening of his gill-covers and lets them pass out through his mouth."

It is difficult to understand how the male fish, which, like other fishes, breathes by taking water in through the mouth and expelling it through the gill openings, can at the same time take in and expel eggs in exactly the opposite direction. Nor does this performance seem to serve any purpose. However, in spite of this criticism of Mr. Hemingway's statement, from his account, from the records of young taken off Cat Cay and Miami Beach, and from G. Smith's (1941) statement that [in Cuba] "the roe is particularly delicious," we feel that scientific exploration of the water from Cuba north to Miami would without much doubt add important data to our knowledge of the life history of the Marlins.

YOUNG: We have only two definite records of young Marlin. One, figured in Plate IV, was taken by Mrs. F. W. Borton, in the Gulf Stream, off Miami Beach, Florida. It weighed five pounds and measured slightly over four feet in length. The other was taken off Cat Cay, B.W.I., by Mrs. Henry Sears. It weighed six and three-quarters pounds. Marlins at this size show the characteristic long dorsal fin and long cylindrical spear of the adult, although the fin is much more even in height and much higher for its entire length than that of the adult, and the lower jaw is not yet as short compared to the upper as it is in the adult.

PLATE V

fig. 1: Adult *Tetrapturus belone* Rafinesque.

Reproduced from Rafinesque, Pl. 1, fig. 1.

SPEARFISH

SPEARFISH

Tetrapturus

The position of the genus *Tetrapturus*, the so-called Spearfish, is undecided, and present evidence seems to the authors insufficient for definite opinion. The question is whether there is really a Spearfish, separate from the Marlins, or whether this fish is the young of some Marlin. There is also a question as to how many of the species identified and described as Spearfish are really Spearfish, provided this genus *Tetrapturus* exists.

As far as the authors can determine, two of the species known as *Tetrapturus* appear to be different fishes from the Marlins despite close resemblance, and the chief difference is in the shape of the dorsal fin at comparable sizes.

Species

In *Tetrapturus belone*, the original Spearfish, described by Rafinesque, this fin is figured and described as high in front and low toward the caudal; but never as high, and always more evenly low, than the dorsal fin of the Marlins. In the Japanese fish, described by Tanaka as *Tetrapturus angustirostris*, the dorsal fin is high in front, but not as low behind as in *belone*. In *T. illingsworthi* Jordan & Evermann, the fin is lower and more blunt in front, and high toward the tail. *T. kraussi* Jordan & Evermann we believe to be the same as *illingsworthi* (which according to the rules of taxonomy has page precedence over the name *kraussi*). In all these forms, it is noticeable that the upper jaw, prolonged into a spear, is shorter in proportion to the lower jaw than in Marlins or Sailfishes of approximately the same sizes.

Playfair's *Tetrapturus brevirostris*, from Zanzibar is a Marlin, and *T. ectenes* Jordan & Evermann may also be a Marlin. The photograph on which the description of *T. ectenes* is based shows a broken spear, and is cut off in the middle of the caudal peduncle. It seems to us insufficient material on which to name a species.

Sanzo (1930) speaks of catching two very young stages of *Tetrapturus belone* Rafinesque (25 mm. and 48 mm.) in the Straits of Messina, but goes on to say that they "coincide with the Atlantic specimens of Lütken and Günther." This makes Sanzo's specimens Sailfish (*Istiophorus*), not *Tetrapturus*.

It is also quite possible that Rafinesque's very poor figure and inadequate description are merely those of a Sailfish.

We feel that the Spearfish may yet prove to be a growth stage of one of the Marlins; a stage at which the body has not yet begun to grow in depth in proportion to its length, and also at which the dorsal is higher than in the succeeding stage. Evidence, however, as far as we can gather it from printed accounts and from our knowledge of the Marlins, does not seem to support this theory. We have been entirely unable to track down any definite eye witness account of the Spearfish in any stage. The Jordan and Evermann photographs upon which their descriptions are based are not very good, some important part of the specimen being invisible in each one of them. However, the portion of the fish visible looks very different from the Marlins. We have examined freshly caught specimens of White Marlin of 7' 10", and Blue Marlin of 6' 4", sizes which approximate those of the "Spearfishes" described as *T. belone* and *T. illingsworthi*, and these both definitely show Marlin characters of the dorsal, as does the four foot Marlin shown in Plate IV, and do not resemble the dorsal of these Spearfishes.

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a 5.5 mm. Sailfish in the Copenhagen Museum. Pl. XVIII = Günther, figures on pp. 98, 99, 100 of 9 mm., 14 mm., and 60 mm. Sailfish in the Museum Godeffroy. Pl. XIX = Cuvier & Valenciennes, Pl. CCXXX, *H. pulchellus*. Pl. XVI = Cuvier & Valenciennes, Pl. CCXXV, a 12" Swordfish, and Lütken, Pl. III, fig. 10, a 37 mm. Swordfish.]

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